Space Weather Technical Forecast

Issued on Wednesday 26 February 2025 at 13:10 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Isolated M-class flares possible. Slight chance of G1 Minor Storms, most likely day 3 (28 Feb).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate activity with one M-class flare. This peaked slightly before this period at M3.6 at 25/1159 UTC from the combination flare from AR3998 and AR3996 in the southwest. These sunspots are now approaching the southwest limb, but remain the most likely source of flaring due to some slight complexity and their potential interaction. There are eight sunspot regions in total across the Earth-facing disc, however the majority of these are small and simple. AR4006 in the northeast is perhaps the next most complex, however this remains relatively simple.

A filament eruption, just west of centre disc, was observed around 26/0600 UTC. This is still under analysis for the occurrence of any CME with an Earth-directed component.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE at L1, showed some weak CME influence, and potentially the first signs of a connection to the first of the coronal hole features on the disc, likely the unnumbered features in the northwest. Background solar wind speeds were observed until 26/1140 UTC, before rising to be slightly elevated at near 430 km/s. Density was often above average, however, rising above around 25/1745 UTC. Interplanetary Magnetic Field, Bt, was Moderate until 26/0630 UTC, when a gradual increasing trend was observed becoming Strong at 17nT by 26/1200 UTC. The north-south component was mainly negative (southward), with minimum -10nT at 26/0505 UTC, before rotating to be mainly northward from 26/1015 UTC peaking 16nT. Phi angle was negative (towards the Sun) at first, before switching positive (away from the Sun) from around 26/0500 UTC. Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was above background, but below the the S1/Minor Radiation and declining. The 24-hour fluence was below the Active threshold (1e8 integrated pfu), recording 1.23e6 integrated pfu at 26/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is forecast with the likelihood of isolated M-class flares.

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Solar Wind / Geomagnetic Activity: Glancing CME influences are currently not expected, but can't be completely ruled out Days 2-3 (27-28 Feb) from the M3.3 flare and filament eruption on 24 Feb. The further filament eruption CME on 26 Feb is still under analysis. The main upcoming enhancement from CH19/+ is likely on Days 2-3 (27-28 Feb), with Strong wind speeds of over 600km/s expected. Wind speeds are likely to remain elevated or strong for the rest of the period, once the fast wind connects with Earth. Quiet to Unsettled geomagnetic activity is expected with Active intervals, most likely with the coronal hole onset Days 2-3 (27-28 Feb).

Energetic Particles / Solar Radiation: High energy proton flux is currently just below the S1 Minor Storm level, and is expected to continue declining towards background, with only a slight chance of further enhancements. High energy electron flux is expected to be at background. The associated 24 hour fluence is expected to remain below the Active (1e8 integrated pfu) threshold.

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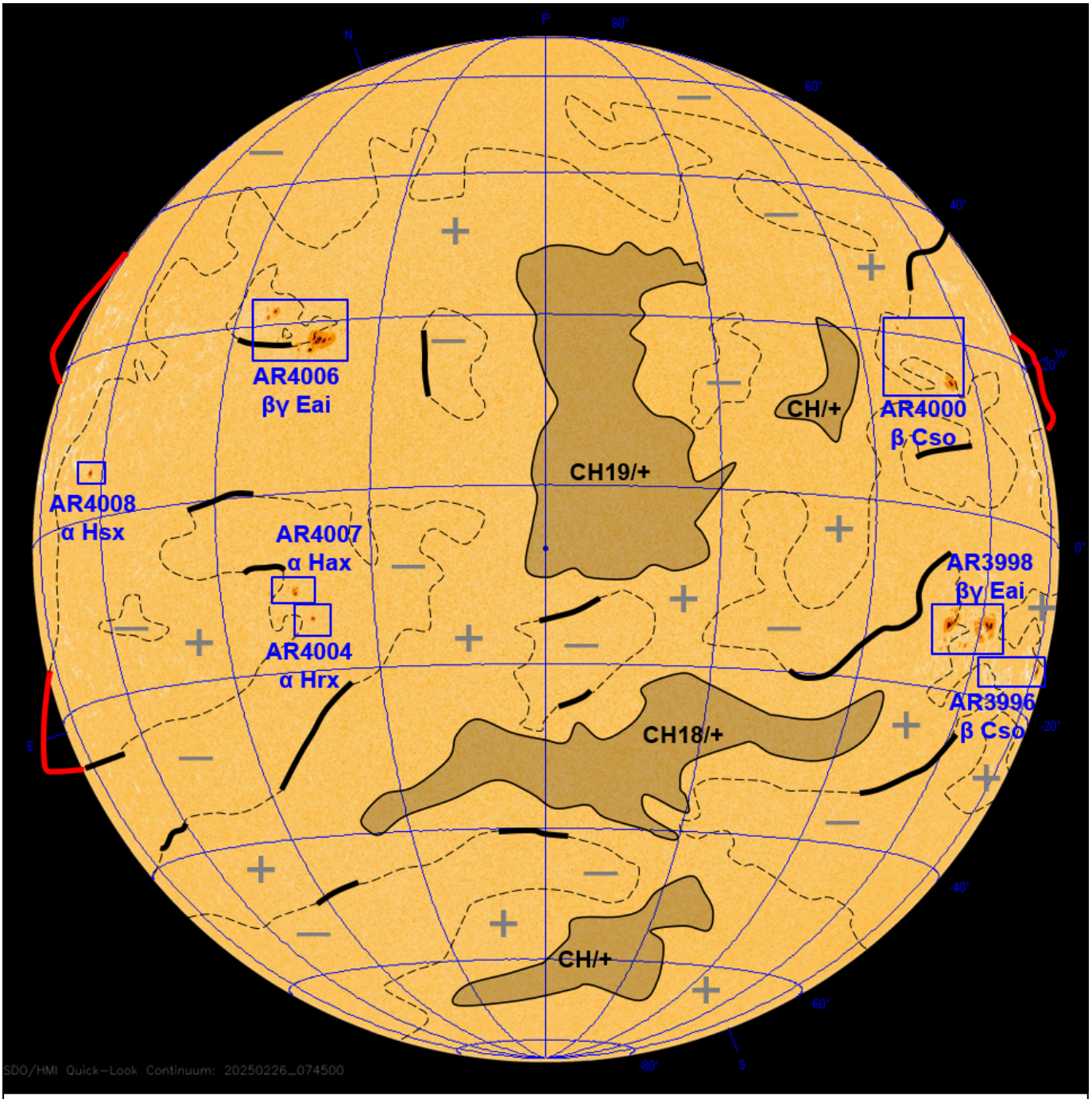
Figure 1: MOSWOC Solar Synoptic Map 26/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

A fast and bright CME off the northwest on 24 Feb obscures a much weaker and fainter signal from the M3.3 flare and associated filament eruption. This signal is identifiable on STEREO A cor2 difference imagery, and this is likely missing north and ahead of Earth's orbit. However, due to the contamination from the far-side event, this assessment is low confidence, and a glancing influence cannot be completely ruled out, most likely to occur during Day 2-3 (27-28 Feb). A further filament eruption was observed from the centre disc around 26/0600 UTC, and this is still under analysis for any Earth-directed impact.

Solar winds at Earth are currently indicative of the slow winds, however weak coronal hole influences are possible day 1-2 (26-27 Feb) likely leading to slightly elevated to elevated solar winds, before the onset of any fast wind from the larger and more significant feature CH19/+, or potentially CH18/+ in the south. This fast wind is expected later on day 2 or more likely day 3 (27-28 Feb), and then likely to continue until the end of the period. This is supported by 27-day persistence, with MOSWOC Enlil perhaps too early to connect to the fastest winds but still indicative of the expected strength once this occurs.

Generally Quiet to Unsettled geomagnetic activity is expected. Active intervals are possible however, along with a slight chance of G1/Minor Storm intervals, either from lingering CME influence on Day 1, any further CME glance Day 2, as well as any coronal hole fast wind onset, particularly Days 2-3.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	10	20	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
24/1414	Partial	AR4000 and filament	NW	448	27/1800 UTC +/-12 hrs	Low confidence. Glancing impact possible, but not expected.

Figure 2: MOSWOC Enlil, showing peak solar winds on 28 Feb

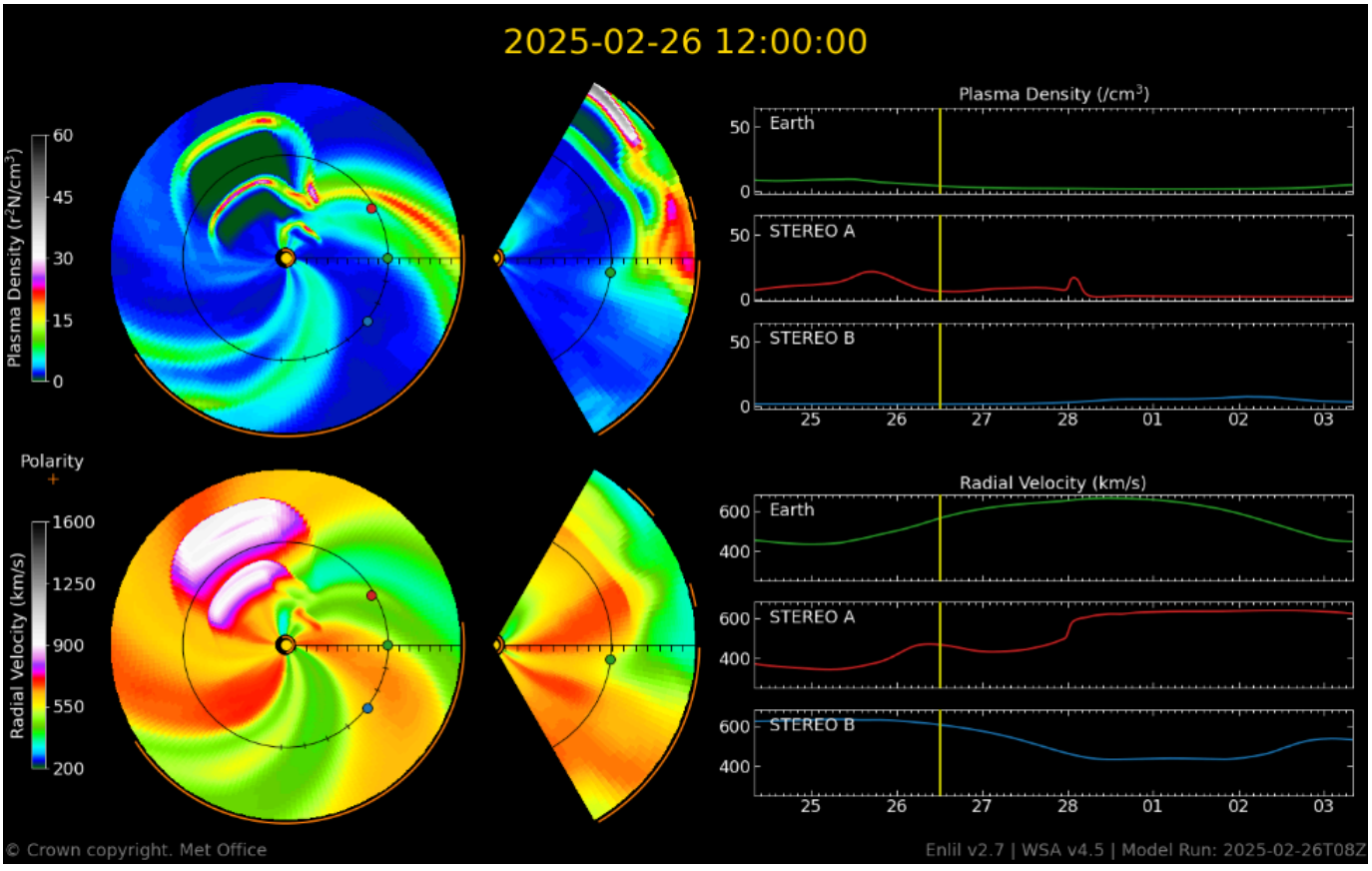

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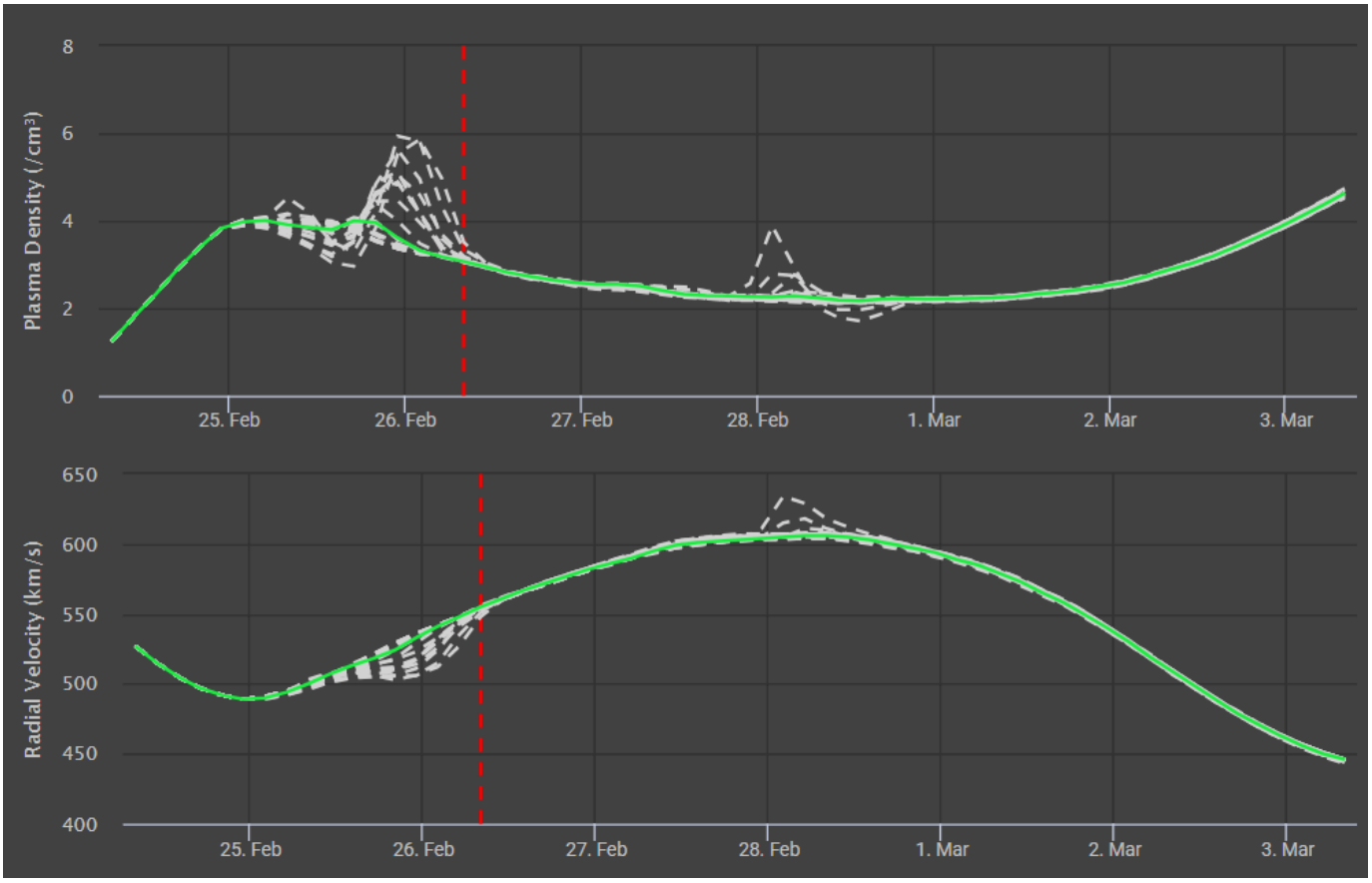
Figure 3: MOSWOC Enlil ensemble, showing slight glancing CMEs possible 27-28 Feb



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Radio Blackouts - X-Ray Flares

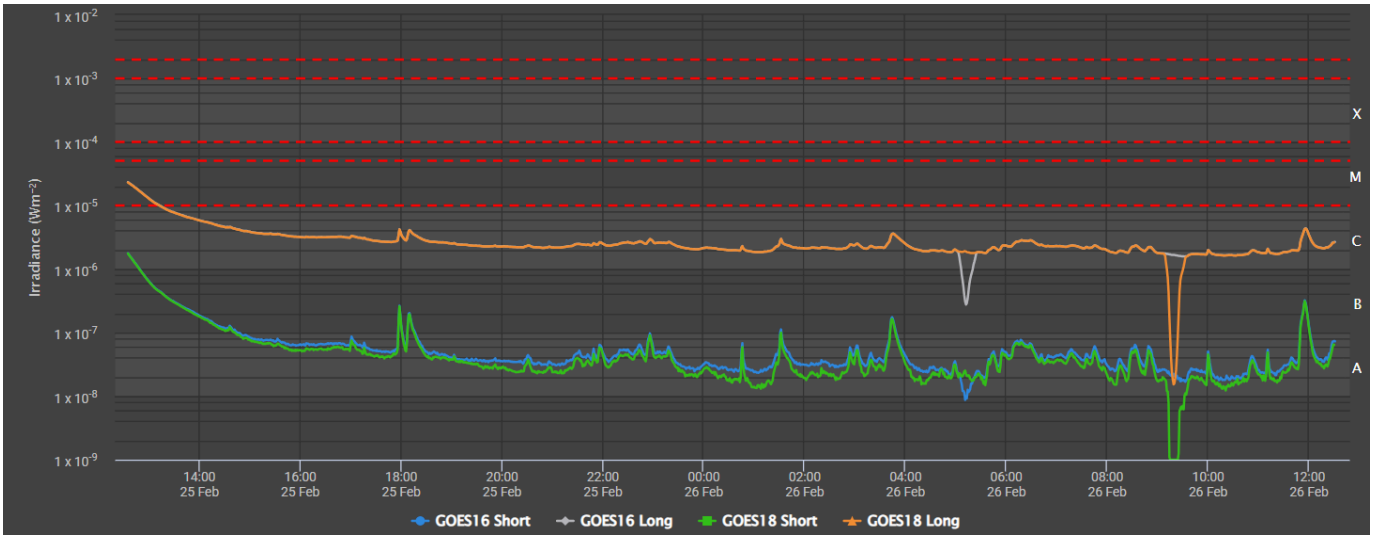
Low to Moderate activity is forecast with the likelihood of isolated M-class flares.

There are eight sunspot regions on the Earth-facing disc. There have generally been showing a simplifying and weakening trend, or have been stable. The most likely flare source is AR3998 in the southwest, which is the largest region on the disc, and has a slightly more interwind magnetic configuration, along with the potential for interaction with weakening AR3996. However this region is likely to rotate over the southwest limb day 3 (28 Feb) and due to approaching the southwest limb this is also becoming increasingly difficult to accurately assess.

The next most complex is AR4006 in the northeast, with some mixing of polarities through its intermediate spots, however this has remained stable and relatively inactive. The other regions are much smaller and simpler.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	60	60	60	60
Very Active	R3-R5 (X Class)	No	5	5	5	5

Figure 4: GOES-16/18 X-ray Irradiance



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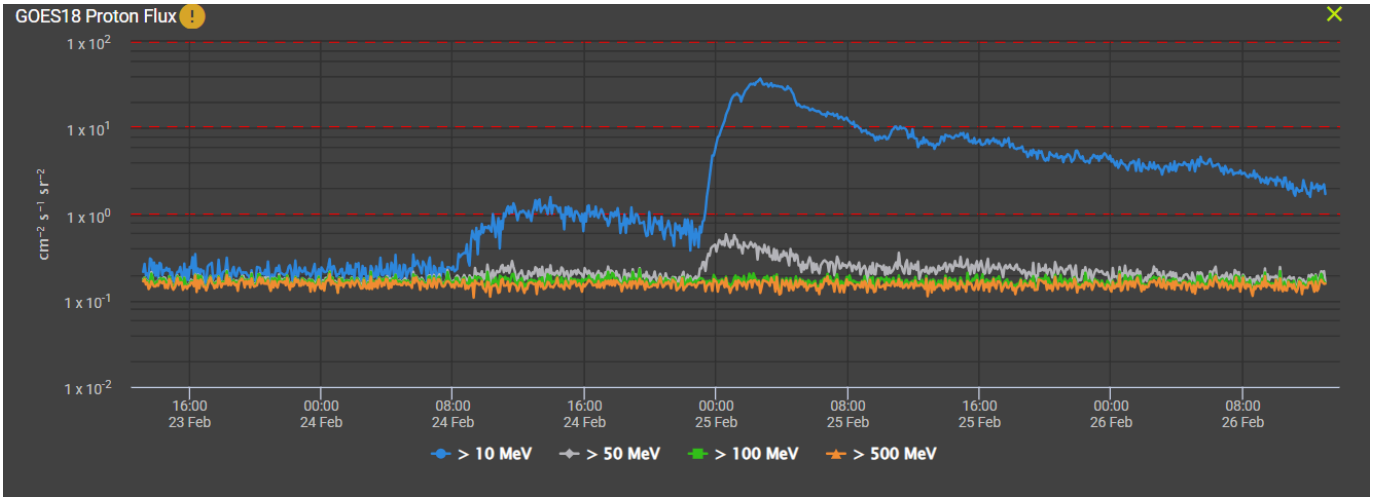
Solar Radiation Storms (High Energy Protons)

GOES-18 high energy (>10MeV) proton flux has been declining after the S1 Minor Radiation Storm that occurred on 25 Feb, and remains slightly above background. This was due to large eruption from over the southwestern limb, however any further enhancement from this source is now less likely as this moves further onto the far-side. The most likely source of any enhancement would be any further flares from AR3998 in the southwest, with an increasing potential from AR4006 as this moves towards and into the western hemisphere.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 5: GOES18 Proton Flux



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High Energy Electrons (≥ 2MeV)

The high energy electron flux (>2MeV), as observed at GOES-16 is at background. While the upcoming fast wind from CH19 (and perhaps CH18) has the potential to increase electron flux in the Van Allen belts later in the period, any response at GEO is expected to occur after the end of this forecast period.

The associated 24 hour fluence is currently below Active. This is expected to continue as suggested by MOSWOC REFM, which is currently providing reasonable guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	1	1	5
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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